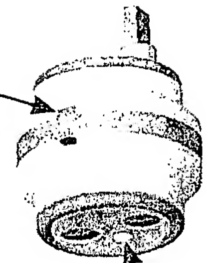

FIG. 1

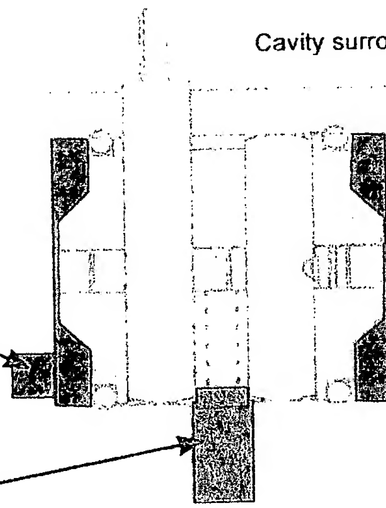

FIG. 2

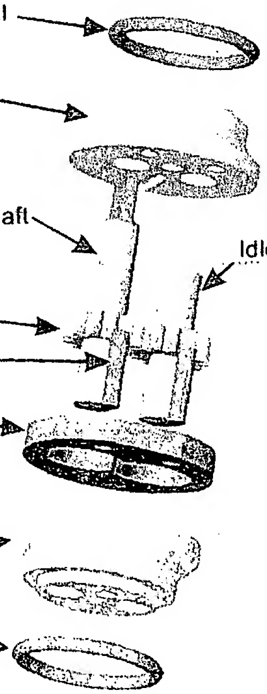

FIG. 3

EXHIBIT 1

Pressure clamping of bi-rotational pump.

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Figure 1 showing axial projection of pressurized area (shaded area).
This area is exposed to the pressure generated by the pump and thus resulting in an axial separating force within the pump.

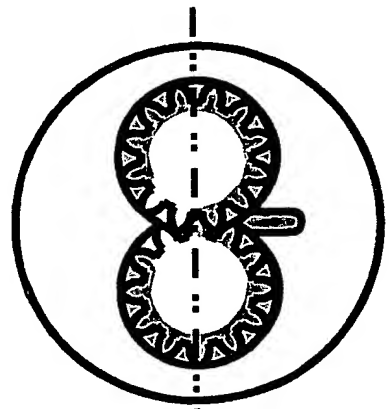

FIGURE 1,
PROJECTION A - A

Figure 2 shows the axial projected pressurized area from either end of pump (shaded area, B - B).
This area is exposed to the pressure generated by the pump and resulting ina clamping force opposing the force in Figure 1.
As the area in Figure 1 is smaller than the area in Figure 2 the resulting force will be a clamping force holding the pump together axially. The net force will force the pump against the opposite end of the cavity.

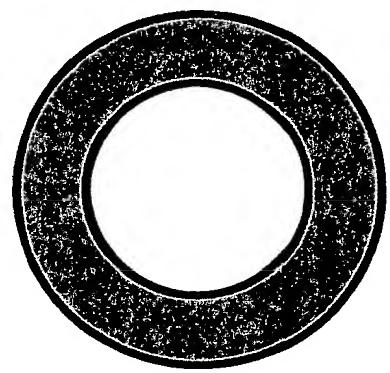

FIGURE 2,
PROJECTION B - B

The above shows the forces in clock wise rotation of the pump. With counter clock wise rotation the area in Figure 1 is mirrored along shown axis in Figure 1 and the axial force changing direction from B - B to C - C.
The result is a pump which is clamped together by its own generated pressure independent of the direction of the rotation, fluid direction.

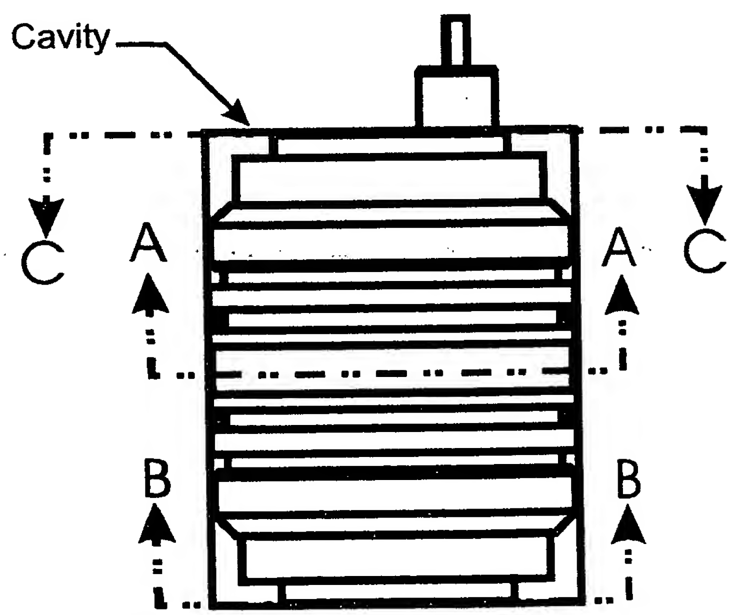

EXHIBIT 2

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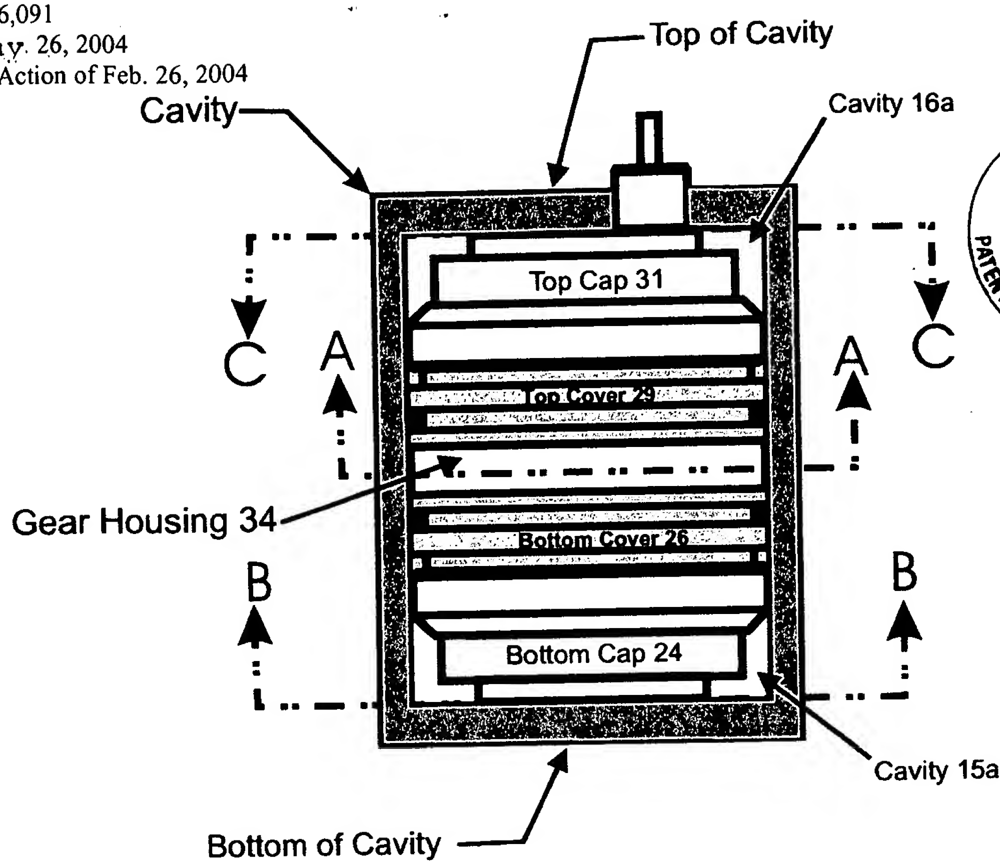


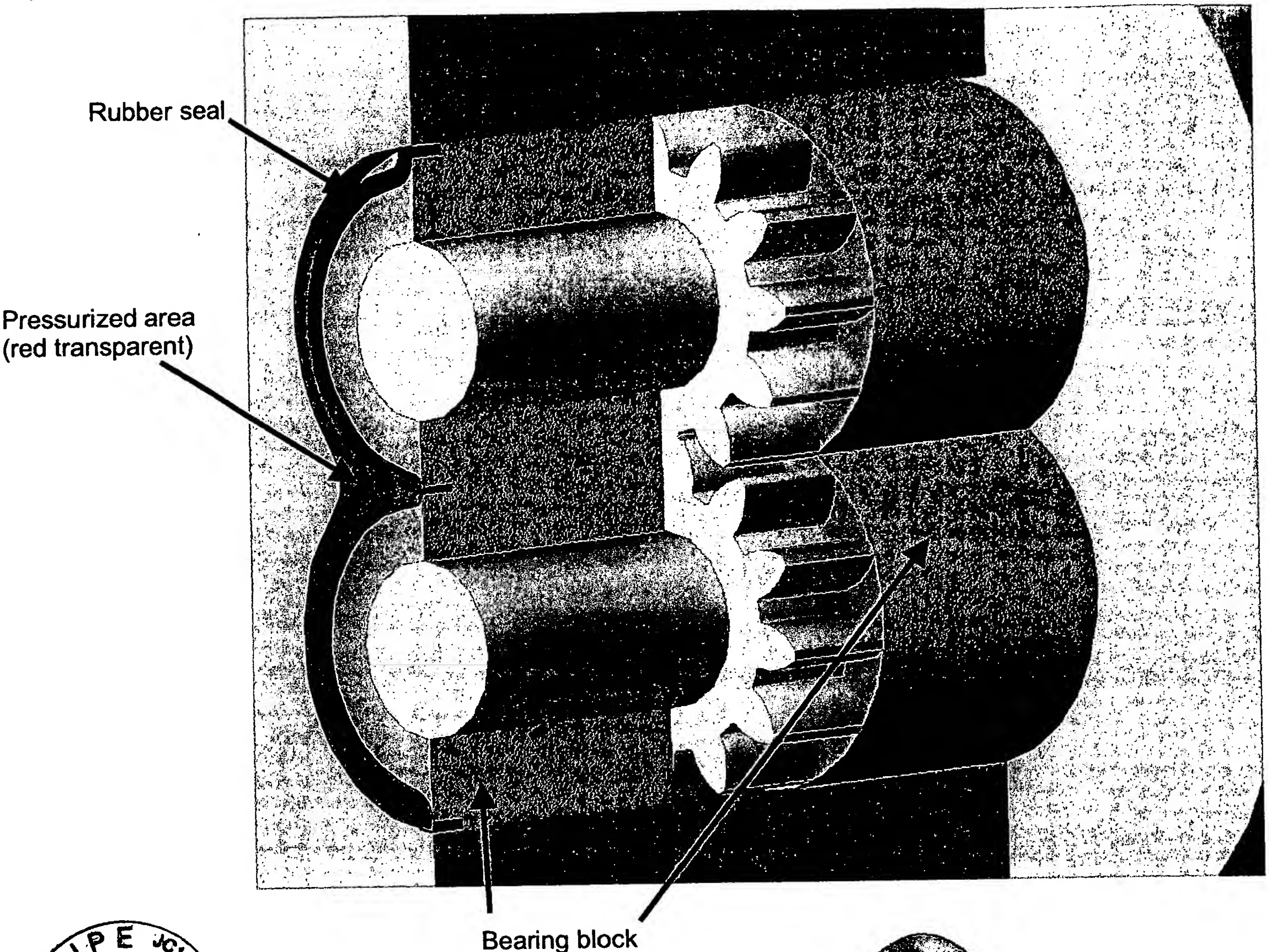
When cavity 15a is pressurized pressure acting at Bottom Cap 24 giving a force directed towards the shaft side of the pump. This force is transferred to the Bottom Cover 26 and then further to the Gear Housing 34. The reaction force from the Gear Housing 34 is then transferred to the top Cover 29, Top Cap 31 and then to the top of the Cavity. The force created by the pressure on the Bottom Cap 24 is then clamping the pump together axially.

By changing the rotation of the pump the pressure will appear in Cavity 16a and the resultant axial force will then be taken up by the Bottom of the cavity and resulting in an axial clamping of the pump.

EXHIBIT 3

Pressure balanced gear pump

as in Dworak and Lipscomb



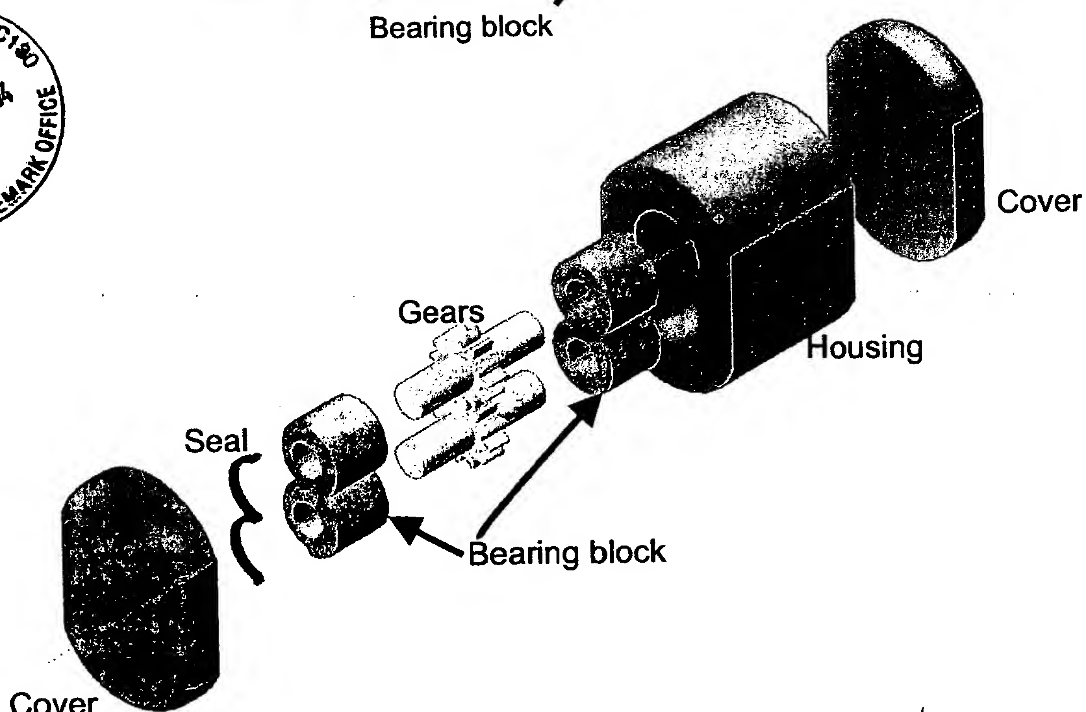


EXHIBIT 4.A

Pressure Balanced Gear Pump

As in Dworak and Lipscomb

The pressure balanced gear pump is a variable clearance pump. The term variable clearance means that the end plates (bearing blocks) are floating and will adjust themselves to proper clearance between the gear face and the face of the bearing block. This is very different from a fixed clearance pump where the clearance is built in as a difference in thickness of the gears relative to the gear housing as in the patent application.

The function of pressure balancing is seen in the enclosed sketch. The bearing block has a groove on the opposite side of the gear face where a seal is placed. This seal together with the gear housing makes a border to a defined area, which is pressurized by the pumps generated pressure. This area is of the same size as the pressurized area on the opposite, gear side. As the same pressure is acting on equal areas on opposite sides the block is balanced and will not move in any direction by the pressure. In order to achieve some force to move the bearing block towards the gear face the seal made out of rubber will act as a spring so there is a slight contact between the gear face and the bearing block.

There must be at least 50 patents around this principle with very slight variations of the same theme. As can be seen Dworak has a large solid bearing block but Lipscomb has a bearing block and a plate, which is pressure balanced. The result is the same the plate or bearing block is balanced by the pumps generated pressure.

The pressure clamped pump is very different as the width of the gears and the gear housing is different to have a defined clearance. The gear housing is sandwiched between the covers and there is nothing that can change the clearance other than deformation of the covers. The covers correspond to the bearing blocks in the pressure-balanced pump. In the pressure clamped pump the covers (bearing blocks) are fixed and in the pressure-balanced pump they are floating axially.

The advantage of pressure clamping is that no bolts are needed to keep the pump together which will stretch and degrade the performance of the pump. Also the size of the pump can be considerably smaller. Note that the same objections were made to the 715 patent.

EXHIBIT 4 B

Pressure Clamped Gear Pump

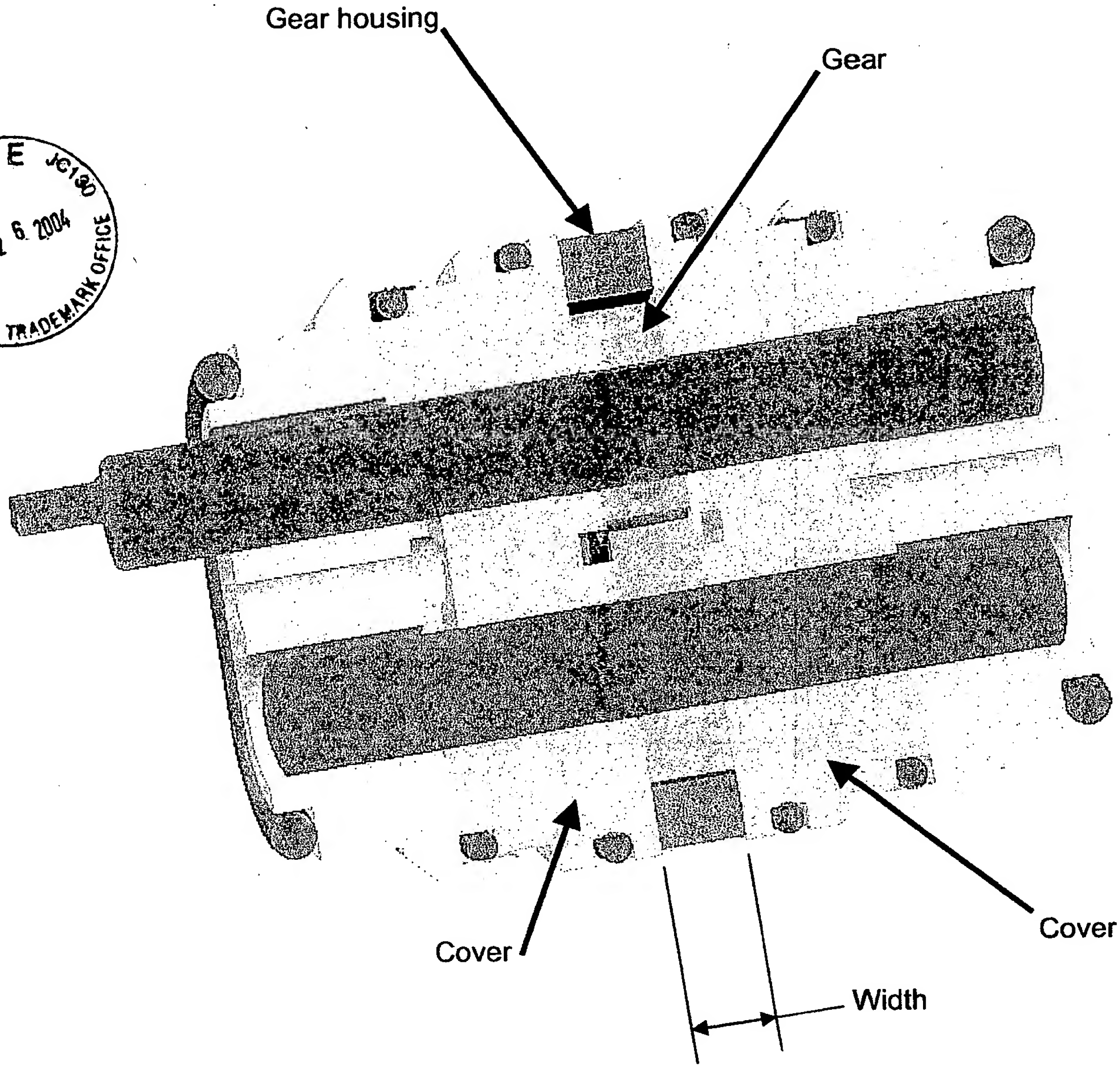


EXHIBIT 5

[0060] For purposes of clarity Fig. 3 is schematic in that the bi-rotational pump **(2a)** and its reservoir enclosure **(13a)** and the actuator cylinder **(3a)**, including piston rod **(4a)** and piston **(4b)**, are shown in distinct, vertically spaced relationship. The reservoir **(13a)** situated below the pump **(2a)**, is the source of fluid which passes (via inlet 8a) into and through the pump into either the lower chamber (15a) or upper chamber (16a) depending upon the direction of the rotation of the pump (2a). [Chambers (15a) and (16a) are separated by wall (14a).] Continued rotation of the pump (2a) and the corresponding gears (40 and 42) urges fluid either out of chamber (15a) or (16a) via conduit (6a) or (7a) upwardly into one or the other ends of the actuator (3a). This liquid pressure in the actuator (3a) causes a movement of the piston (4b) and connected piston rod (4a) in either a retract or extend direction. The above discussion of FIG. 3 is more detailed in the explanation of FIGS. 4, 5 and 6 hereinafter taken also with the data in TABLE X below in which Column 1 identifies the ball valves in question.

TABLE X

VALVE	**FIG. 4 No Rotation**	**FIG. 5 ccw Lower Chamber (15a) Extend**	**FIG. 6 cw Upper Chamber (16a) Retract**
23	valve closed	valve closed	valve open
18a	" closed	" open	" closed
21a	" closed	" open	" closed
30	" closed	" closed	" open
20a	" n/a	" closed	" open
28	" n/a	" open	" closed

The other columns identify FIGS. 4, 5, and 6 showing the position of the valve as either open or closed, depending upon the rotation of the driveshaft (35) and the connecting gears. FIG. 4 shows the valve position where there is "no rotation" of the driveshaft (35). FIG. 5 shows the position of the various valves (open or closed) where the rotation of the driveshaft (35) is counterclockwise (ccw). FIG. 6 shows the open or closed position of the corresponding valve when the driveshaft (35) is rotating in a clockwise (cw) rotation. TABLE X also shows in the column headed FIG. 5 that the piston (4b) is in an extended direction with counterclockwise rotation while

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FIG. 6 shows that the valve positions, as shown, for achieving a retracting movement of the piston (4a) and the connected piston rod (4b).

[0061] In FIG. 4, as noted in TABLE X, represents a "no rotation" position of the driveshaft (35) and wherein valves (23), (18a), (21a) and (30) are closed. They are closed because with "no rotation" of the driveshaft (35) there is no pressure in either chamber (15a) or (16a) to actuate the pilot pistons (19a) or (25), either of which would open the corresponding valves (18a) or (23) respectively. Likewise valves (30) and (21a) are closed and held closed by the spring as shown because there is no pressure to overcome the resistance of the spring holding the respective valves (30) and (21a) in the closed position.

[0063] Referring to FIG 5 and TABLE X the driveshaft (35) is rotating in a counterclockwise (ccw) direction resulting in a gradual build up of pressure in the lower chamber (15a). As a result of the pressure exerted upwardly against pilot piston (19a) sufficient to compress the ball (18a) against the opposed spring thereby opening valve (18a). Simultaneously the pressure build up in the lower chamber (15a) compresses ball (21a) against the opposed spring opening the valve (21a). Also simultaneously the ball valve (20a) is held in the closed position by the increased pressure. More importantly the more increased pressure causes the fluid to proceed as exiting (as shown by the arrow) out conduit (6a) into the right side of the actuator (3a) exerting pressure on the piston (4b), this forces the piston (4b) to the left to the extend position. This displaces the liquid to the left of piston (4b) down conduit (7a) and into the upper chamber (16a) as noted. This gradually increases the pressure in the upper chamber (16a), which is relieved by the opening or the downward movement of the ball (28) and also the valve (18a) urged upwardly by the pilot piston (19a). Of course, the pressure in chamber (15a) still occurs by reason of the counterclockwise movement of the driveshaft (35) and the intermeshing gears (40 and 42).

[0064] Referring now to FIG. 6 and TABLE X the parts/components of the pump (2a) and the actuator (3a) are shown when the drive shaft (35) is moving in a clockwise (cw) direction of rotation, resulting in movement of

EXHIBIT 6
page 2 of 3

the piston (4b) to the right into the retracted position. The fluid from the pump (2a) now exerts pressure causing the ball valves (28, 18a, 21a) that were open to become closed and ball valves (23, 30, 20a) that were closed to become open. As a result then, this reversal of the rotation causes the fluid to move out of the upper chamber (16a) under pressure, through conduit (7a) into the actuator (3a) to the left of piston (4b). This in turn moves liquid out of the opposite end of the actuator (3a) down conduit (6a) into the lower chamber (15a) and through valve (23) back to the reservoir (13a) to initiate a reversal to the FIG. 5 condition by reason of changing the rotation of the pump (2a) from clockwise (cw) to counterclockwise (ccw).

EXHIBIT 6
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